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Architectural Drafting Needs as Indicated by Selected Iowa Industries, Architects, and Engineering Firms.

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To determine the number of architectural draftsmen needed in the state of Iowa and the skills and knowledge they should possess, 297 industries, architects, and engineering firms were surveyed with an 83.84 percent response. Major objectives were: (1) to identify employers of architectural draftsmen, (2) to ascertain skills and technical knowledge needed, (3) to determine the demand for architectural draftsmen at the time of the study and the projected demand for the next 5 years, and (4) to determine the present source of architectural draftsmen presently being employed. Employers desired draftsmen to be proficient in verbal communication, spelling, listening and note taking, advanced arithmetic, plane geometry, and basic algebra as well as various drafting practices. The minimum recommended level of education for the 599 architectural draftsmen needed in the state of Iowa in the next 5 years is vocational-technical school or some college education. Some conclusions were (1) there is a need for well-trained architectural draftsmen, (2) programs for their training should be developed in Iowa's post-secondary schools, (3) the main source of presently employed draftsmen is colleges and universities, and (4) it is difficult for firms to accurately predict the number of additional employees needed beyond 1 year. (DM)

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# ARCHITECTURAL DRAFTING NEEDS AS INDICATED BY SELECTED IOWA INDUSTRIES, ARCHITECTS, AND ENGINEERING FIRMS.

by

Richard Arlen Wilson

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IOWA STATE UNIVERSITY
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This is an abstract of a thesis submitted to Iowa State University of Science and Technology by Richard Arlen Wilson in partial fulfillment of the requirements for the degree Master of Science.

The study was conducted with the cooperation of the Iowa State Department of Public Instruction and the Industrial Education Department at Iowa State University.

The study was conducted under the direction of Professor Lowell L. Carver.

ED025643

# ARCHITECTURAL DRAFTING NEEDS AS INDICATED BY SELECTED IOWA INDUSTRIES, ARCHITECTS, AND ENGINEERING FIRMS

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## PURPOSE OF THE STUDY

The real revolution of modern times is educational, vocational education. Both federal and state support have provided the momentum and incentive for the establishment of area vocational technical schools and area community colleges in Iowa. With this establishment, research, such as this for architectural draftsmen, is needed to insure the continued success of education designed to qualify the graduate for entry employment in a job.

This research study is a vehicle of valid and reliable knowledge upon which to base sound educational programs to educate architectural draftsmen. This study could not possibly supply all of the answers but this and future studies will help educators establish programs to educate the architectural draftsman.

The response of representatives of Iowa industries, architects, and engineering firms who completed the questionnaire reflects the sincere partnership schools and industry have. It also reflects the need for educational programs to educate the architectural draftsman. The public relations effort was no small part of conducting this research study and the cordial reception the author received when making personal contact was rewarding. The area schools and the many firms visited were most receptive and gave freely of their valuable time.

In Iowa, as in many states, two years or less is a short time in which to prepare students for technical and semi-professional careers. Research concerning curricula in architectural drafting is particularly helpful to advisory committees. They are then in a better position to recommend changes in curriculum, instruction and advisement. When the bonds of partnership between schools and industry are strengthened in this way, all involved benefit -- especially the student.

In view of the needs the following objectives of this study were:

1) To identify the Iowa industries, architects, and engineering firms which employ architectural draftsmen.

2) To ascertain the skills and technical knowledge which the Iowa industries, architects, and engineering firms desire their architectural draftsmen to possess.

3) To determine the number of architectural draftsmen needed to fill the needs of Iowa industries, architects, and engineering firms now and projected for the next five years.

4) To determine the present source of architectural draftsmen being hired by Iowa industries, architects, and engineering firms.

It is hoped that this study will aid in the formulation of both the number and content of architectural drafting education in Iowa Vocational Technical Area Schools and Community Colleges.

## Delimitations

The scope of this investigation was confined to a study of those selected industries, architects, and engineering firms in Iowa that employ, or will in the near future employ, architectural draftsmen. The population of this study was the total population of Iowa industries, architects, and engineering firms.

It is not the purpose of this study to construct a course of study but to serve as a reference and guide to the educator and his advisory committee interested in up-dating or creating effective programs for the architectural drafting student.

## Definitions

In order to clarify the meaning of various terms used in this study, the following definitions were made:

1) Architectural draftsman (summarized from D.O.T. 001.281)--- prepares clear, complete and accurate working drawings and plans architectural and structural features of any class of building and like structures.

2) Area community college---a post-high school publicly supported institution which offers two years of arts and sciences, pre-professional, or other instruction partially fulfilling the requirements for a baccalaureate degree but which does not confer a baccalaureate degree and which offers in whole or in part the curriculum of a vocational technical school.

3) Area vocational technical school---a post-high school publicly supported institution which offers as its curriculum vocational or technical education, training or retraining available to persons who have completed or left high school and are preparing to enter the labor market; persons who are attending high school who will benefit from such education or training but who do not have the necessary facilities available in the local high school; and persons who, due to academic, socio-economic or other handicaps are prevented from succeding in regular vocational or technical education programs.

4) Merged area---an area where two or more county school systems or parts thereof merge resources to establish and operate an area vocational technical school or an area community college in the state.

## Funding

A research proposal stating the problem objectives, administration, procedures and proposed budget was submitted to the State of Iowa, Department of Public Instruction, Division of Vocational Education, State Committee for Research Demonstrations and Experiments. The research proposal was approved by the committee and the study was instituted.

## METHOD OF PROCEDURE

After the research project was approved, the first requirement was to visit with those involved in the most recent survey of needs of architectural drafting personnel conducted jointly by the Iowa Chapter, American Institute of Architects, and the State Vocational Education Division. The thought was to move ahead with this broader study identifying firms employing architectural draftsmen, their educational background and determining the skills and knowledge needed. Also, to make a real effort to project the needs now and for the next five years.

With the knowledge that no complete listing of Iowa firms employing architectural draftsmen was available the enormous task of developing such a list was begun. The most complete and comprehensive list was developed by making direct contact with the following agencies:

The Iowa Development Commission
The Iowa State Manpower Development Council
The Center for Industrial Research and Service at Iowa State University
Associated General Contractors of Iowa
Mechanical Contractors Association of Iowa Inc.
National Electrical Contractors Association, Iowa Chapter
Iowa Manufacturers Association
Iowa Lumbermen's Association
Home Builders Association of Iowa
Iowa Engineering Society
Iowa Mobile Home Association
Iowa Chapter, American Institute of Architects
Association of General Contractors of America, Master Builders of Iowa Chapter
Consulting Engineering Companies of Iowa

Some of these groups had no architectural draftsmen involved and others were not knowledgeable of exact firms within their association which had architectural draftsman so further research was necessary.

A short from double postcard questionnaire was prepared asking if the recipient firm did employ architectural draftsmen, if they would in the next five years, and with whom to make contact in their firm for additional information. This short form double postcard questionnaire was mailed to 1,114 addresses provided mainly by the Associated General Contractors of America, Master Builders of Iowa Chapter, and the Iowa Lumbermen's Association. From the many returned postcards this elicited 27 positive responses to be included in the final population.

From the sources indicating a personal knowledge or a strong supposition that architectural draftsmen were employed by the firms listed, 270 firms were directly placed into the final population. The majority of these addresses, with the proper individual to contact in each firm, came from:

The Iowa Chapter, American Institute of Architects
The Iowa Mobile Home Association
Consulting Engineering Companies of Iowa
Home Builders Association of Iowa (through 13 local secretaries)
Iowa Manufacturers Association

No local, county, state or federal agencies were included in the population. This made a total population of 297 firms.

While this total population was being developed, a questionnaire, the instrument used to collect the data for this study, was under construction. The mailed questionnaire was similar to that used by other researchers but related directly to architectural drafting. The questionnaire was developed from surveying the curriculums of 20 post-secondary schools in the United States and Canada which prepare architectural draftsmen, and from the suggestions of persons involved in education with knowledge of research. A field-check of the questionnaire through contacts and discussion with 19 architects, building contractors, and college professors was made. The executive board of the Iowa Chapter, American Institute of Architects, added three questions. The field-check advice helped tremendously in developing a usable questionnaire. The form then was submitted to an Educational Research Seminar at Iowa State University and, with minor changes, was developed into its final form.

The main questionnaire was constructed in several parts to collect the necessary data to fulfill the objectives of the research project. The first section covers general education with English, Mathematics, Science and Social Studies as subheadings. Next covered was the architectural talents considering drafting practices and construction practices. Space was provided for additional comments by the respondents. There was a

rating scale for these sections for the appropriate value to be checked for each item as follows: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 -- important; and 5 -- essential. The level of education of currently employed architectural draftsmen was asked next with an evaluation of how well each was trained. Then the minimum level of education an architectural draftsman could have and still meet the needs of the employer was asked as well as what the expected annual salary could be at the beginning, with three years of experience, and with five years of experience. A table relating to employment with present and estimated need was included.

The final form of the main questionnaire and cover letter was mailed to 297 Iowa industries, architects, and engineering firms. The Iowa Chapter, American Institute of Architects, furnished an additional letter to be included with their members questionnaires. Each company was given, in the enclosed cover letter, the option of filling out the questionnaire and returning it or, if for some reason they did not feel it applied to their company, returning it with a brief explanation.

After three weeks, 100 follow-up letters and questionnaires were mailed to firms who had failed to respond to the original letter and questionnaire. This follow-up letter was undated and designed so that it could be used as a second follow-up letter. It was sent as a second follow-up letter approximately five weeks after the original. Several phone calls were utilized and this brought the total response to 83.84 percent. Of the total 297 population, 249 responded. When returned, each questionnaire was checked to determine the completeness of the information and the area school code was marked on it. There were 84 firms who returned the questionnaire blank, saying the survey did not apply to their company. There were two questionnaires completed by out-of-state firms and these were not utilized because this study was for in-state firms only. One questionnaire was partially filled out and this was too incomplete to be of value to the study. With the total of 249 responses to the 297 population, it was felt that it was time to begin the task of reviewing the 162 usable questionnaires and coding them to be recorded on two 80 column IBM business machine cards by key punch. These punch cards were utilized at the Computer Center at Iowa State University for sorting and tabulating the necessary data for the study. The data was then presented in tabular and graphic form.

Throughout the last phase of this study, personal follow-up interviews were made to five area schools, and leading Iowa industries, architects, and engineering firms nearby involved in the study, gaining a clearer understanding of architectural drafting needs. This travel was to Eastern, Western, and Central Iowa visiting Davenport, Muscatine, Cedar Rapids, Des Moines, Council Bluffs and Sioux City.

The State of Iowa Department of Public Instruction requested a preliminary analysis of architectural drafting needs as indicated by selected

Iowa industries, architects, and engineering firms and this report was made on August 7, 1968. This meeting was attended by: Dr. Kenneth Wold, Director of Research Coordinating Unit; Mr. Harlan Giese, Chief Technical and Trade and Industrial Education; and Dr. Wayne Zook, Consultant.

A summary of the findings was sent to the 15 area schools in the state and to those participants who checked in the questionnaire that they desired a summary when the study was completed.

## FINDINGS

This study was a survey of Iowa industries, architects, and engineering firms which employ architectural draftsmen. The survey was conducted by mailing 1,114 short form double postcard questionnaires and utilizing 14 agencies to develop a usable total population of 297 firms. A main questionnaire was mailed with a total of 249 returns for an 83.84 percent response. The data from 162 usable questionnaires, with personal follow-up interviews to leading Iowa industries, architects, and engineering firms throughout the state of Iowa and five area schools, were utilized in this study.

The size distribution of responding firms, is presented in Table 1 and is categorized by merged area schools in Iowa, and indicates the diversity of size of firm participating in the study. The category of 10 thru 19 employees had the greatest representation in the study with 43 responding firms. However, from the standpoint of employed architectural draftsmen, the firm size 10 thru 19 and 20 thru 49 employed 52.16 percent of the total architectural draftsmen in the state (see Table 16). With the exception of merged area XIV, all were represented with at least one firm. Area XI, centrally located and one of the largest areas in the state, had the most firms responding with a total number of 56. Ninety-two of the 162 industries responding, or 57 percent, were located in Areas IX, X, and XI. There were no respondents from the firm size category of 500 thru 849, while the majority, over 78 percent, were represented by firms of less than 50 employees.

Data relevant to fulfilling the objectives of the study were obtained from the questionnaire, giving information about the occupation of, and the education for, architectural draftsmen. The sequence of tables in this chapter parallels the order of the questionnaire in covering the objectives of the study. Those objectives were:

1) To identify the Iowa industries, architects, and engineering firms which employ architectural draftsmen.

Table 1. Distribution of responding firms by size and merged area in Iowa[a]

| Size by number of employees | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII | XIV | XV | XVI | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No response | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 2 | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 16 |
| Less than 4 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 5 | 3 | 8 | 2 | 0 | 0 | 2 | 0 | 23 |
| 4 thru 9 | 0 | 2 | 0 | 1 | 2 | 2 | 6 | 0 | 3 | 1 | 14 | 4 | 0 | 0 | 1 | 0 | 36 |
| 10 thru 19 | 1 | 2 | 1 | 1 | 5 | 3 | 4 | 1 | 2 | 7 | 11 | 0 | 1 | 0 | 2 | 2 | 43 |
| 20 thru 49 | 2 | 1 | 0 | 1 | 3 | 1 | 0 | 1 | 0 | 4 | 9 | 2 | 0 | 0 | 0 | 0 | 24 |
| 50 thru 99 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 12 |
| 100 thru 249 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| 250 thru 499 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| 500 thru 849 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 850 or more | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 |
| Total | 3 | 8 | 3 | 3 | 13 | 8 | 11 | 3 | 17 | 19 | 56 | 9 | 1 | 0 | 5 | 3 | 162 |

[a]For location of merged areas see page 31.

(2) To determine the skills and knowledge which the Iowa industries, architects, and engineering firms desire their architectural draftsmen to possess.

(3) To determine the number of architectural draftsmen needed to fill the needs of Iowa industries, architects, and engineering firms now and projected for the next five years.

(4) To determine the present source of architectural draftsmen being hired by Iowa industries, architects, and engineering firms.

The directions in the questionnaire asked the respondent to check the appropriate column as to how much value should be placed on each item in training architectural draftsmen. The rating scale was: 1 for no value; 2 for little importance; 3 for desirable; 4 for important; and 5 for essential.

From the data, frequency counts, means and standard deviations were computed. The frequency count is merely how often each of the above five ratings were checked. The mean is the sum of all these numerical values, divided by the number of these values. This is often called the average or the arithmetic mean. The mean is a measure of central tendency, the composition of which is influenced by the actual size of each value in a distribution. The standard deviation is the square root of the mean of the squares of the individual deviation from the mean of the distribution. It takes into account the size of every value in a distribution. In a normal distribution approximately two-thirds of the cases lie between a standard deviation distance below the mean and a standard deviation distance above the mean.

Tables 2, 3, 4, and 5 present the general educational background desired. As indicated in Table 2, verbal communication was first with a mean of 4.34. There were 64 respondents who indicated that this was important and 81 checking that it was essential. A standard deviation of .83 for verbal communication was also good. Second ranked was spelling, having a mean of 4.20 and a standard deviation of .88. There were 69 respondents indicating this was essential and 66 of 162 respondents who checked that spelling was important. Ranked third in the English section was listening and note taking with a mean of 4.19 and a standard deviation of .92. There were 73 who had checked column five in the questionnaire indicating a value of essential for listening and note taking. Fifty-eight had checked column four, which was the important value. This would indicate as essential a proficiency in verbal communication, spelling, and listening and note taking. For a comparison, proficiency in essay writing ranked lowest with a mean of 2.41 and a standard deviation of .96. Here there were 25 checking of no value, 59 checking of little importance. Only four indicated that essay writing was essential. Of the comments made on questionnaires in the English section were two commenting that public speaking was essential. Two other comments were needs for memory training and composing terse instructions on plans.

Table 2. Importance of proficiency in English for architectural draftsmen as viewed by employers

| Rank | Category | Mean | Standard deviation |
|---|---|---|---|
| 1 | Verbal communication | 4.34 | .83 |
| 2 | Spelling | 4.20 | .88 |
| 3 | Listening and note taking | 4.19 | .92 |
| 4 | Grammar | 3.62 | .97 |
| 5 | Business correspondence | 3.26 | .99 |
| 6 | Technical report writing | 2.91 | 1.05 |
| 7 | Essay writing | 2.41 | .96 |

Rating: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 -- important; 5 -- essential

Table 3. Importance of proficiency in mathematics for architectural draftsmen as viewed by employers

| Rank | Category | Mean | Standard deviation |
|---|---|---|---|
| 1 | Advanced arithmetic | 4.20 | 1.06 |
| 2 | Plane geometry | 4.05 | .99 |
| 3 | Basic algebra | 3.99 | .92 |
| 4 | Slide rule | 3.73 | 1.20 |
| 5 | Descriptive geometry | 3.52 | 1.13 |
| 6 | Desk calculator | 3.44 | 1.20 |
| 7 | Trigonometry | 3.44 | 1.20 |
| 8 | Analytical geometry | 3.31 | 1.20 |
| 9 | Advanced algebra | 3.23 | 1.13 |
| 10 | Data processing | 2.59 | 1.30 |
| 11 | Calculus | 2.10 | 1.06 |

Rating: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 - important; 5 -- essential.

As portrayed in Table 3, mathematical ability in advanced arithmetic had a mean of 4.20 and a standard deviation of 1.06. There were 83 checking advanced arithmetic as essential and 47 checking it as important. Plane geometry had a mean of 4.05 and a standard deviation of .99. Sixty-four had checked it essential and 59 important. The third rank went to basic algebra with a mean of 3.99 and a low standard deviation of .92. Calculus ranked 11th, having a mean of 2.10. No comments were added in this mathematics section.

Table 4. Importance of proficiency in science for architectural draftsmen as viewed by employers

| Rank | Category | Mean | Standard deviation |
|---|---|---|---|
| 1 | General physics | 3.34 | .99 |
| 2 | Statics and dynamics | 2.97 | 1.06 |
| 3 | General chemistry (inorganic incl.) | 2.49 | .95 |
| 4 | Electronics and electrical physics | 2.47 | .96 |
| 5 | Thermodynamics | 2.25 | 1.02 |
| 6 | Metallurgy | 2.15 | 1.01 |
| 7 | Quantitative analysis | 1.95 | .94 |
| 8 | Organic chemistry | 1.85 | .89 |
| 9 | Atomic and nuclear physics | 1.65 | .85 |

Rating: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 -- important; 5 -- essential

Examination of Table 4 revealed that many areas of science were ranked as having little or no value. General physics had a mean of 3.34 and a standard deviation of .99 for the high.

The importance of a proficiency in social studies was illustrated in Table 5. Business economics ranked high with a mean of 3.01 and both sociology and psychology had a mean of 2.73 for low.

In the "other" section of general education, comments listed on individual returned questionnaires were: typing and product knowledge with essential ratings; computer graphics and computer programming as important; and outlining as desirable.

Table 5. Importance of proficiency in social studies for architectural draftsmen as viewed by employers

| Rank | Category | Mean | Standard deviation |
|---|---|---|---|
| 1 | Business economics | 3.01 | 1.04 |
| 2 | Business law | 2.84 | 1.05 |
| 3 | Sociology | 2.73 | .91 |
| 4 | Psychology | 2.73 | .97 |

Rating: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 -- important; 5 -- essential

Tables 6 and 7 covered the architectural talents needed by architectural draftsmen. Demonstrated in Table 6 were many drafting practices which rated very high. The category of blueprint reading had 142 out of 162 questionnaires rating it as essential, giving it a high mean of 4.78 and a low standard deviation of .72. Through examination of Table 6 the next five categories (dimensioning, architectural lettering, architectural symbols, types of lines and line quality, and detailing) all ranked high with low standard deviations. Nineteen of the 42 categories listed had means of 4.01 or better, showing their importance educationally to the architectural draftsman. Other items listed on the questionnaire in the drafting practices section were: kn w industries standards for products, be able to figure things out, be a good neat draftsman or woman, adaption to field work, sanitary and storm sewers, schedules and legends.

Appearing in Table 7 were the results of the construction practices section. There were no means higher than 3.75, which was main structure familiarity. The mean for 25 of the 27 items listed had only a variation of .71 and a variation of only .84 for all 27. The category of roof construction and surfaces was second high with a mean of 3.60 and structural steel was third with a mean of 3.57. The low mean of 2.91 was for air cleaning and ranked 27th. Other comments in the construction practice section were, again, be able to figure things out and be a good neat draftsman or women.

Table 6. Importance of proficiency in drafting practices for architectural draftsmen as viewed by employers

| Rank | Category | Mean | Standard deviation |
|---|---|---|---|
| 1 | Architectural blueprint reading | 4.78 | .72 |
| 2 | Dimensioning | 4.52 | .94 |
| 3 | Architectural lettering | 4.51 | .84 |
| 4 | Architectural symbols | 4.48 | .95 |
| 5 | Types of lines and line quality | 4.40 | .88 |
| 6 | Detailing | 4.39 | .87 |
| 7 | Architectural conventions | 4.33 | 1.01 |
| 8 | Sections | 4.31 | .99 |
| 9 | Elevations | 4.31 | 1.00 |
| 10 | Floor plans | 4.23 | 1.05 |
| 11 | Drafting room standards | 4.19 | .99 |
| 12 | Design and structural detailing | 4.15 | .95 |
| 13 | Framing plan | 4.14 | 1.03 |
| 14 | Footing plans | 4.11 | 1.09 |
| 15 | Orthographic projection | 4.10 | 1.09 |
| 16 | Construction methods | 4.05 | 1.05 |
| 17 | Construction materials | 4.04 | 1.02 |
| 18 | Trade terminology | 4.02 | 1.07 |
| 19 | Site plans | 4.01 | 1.01 |
| 20 | Freehand sketching | 3.96 | .88 |
| 21 | Perspective | 3.91 | .94 |
| 22 | Paper layout | 3.86 | 1.12 |
| 23 | Structural drawings | 3.83 | 1.03 |
| 24 | Isometric drawing | 3.82 | 1.07 |
| 25 | Topography | 3.78 | 1.11 |
| 26 | Mechanical considerations | 3.67 | .89 |
| 27 | Types of pencils | 3.60 | 1.11 |
| 28 | Building codes | 3.59 | 1.03 |
| 29 | Oblique drawing | 3.58 | 1.17 |
| 30 | Reproductions | 3.53 | .98 |
| 31 | Electrical drawings | 3.52 | .95 |
| 32 | Specifications | 3.52 | 1.16 |
| 33 | Types of papers | 3.46 | 1.10 |
| 34 | Building estimating | 3.39 | 1.11 |
| 35 | Graphs and charts | 3.38 | 1.01 |
| 36 | Renderings | 3.38 | 1.02 |
| 37 | Model building | 3.25 | 1.01 |
| 38 | Electrical codes | 3.22 | 1.01 |
| 39 | Plumbing codes | 3.19 | 1.00 |
| 40 | Contracts | 2.93 | 1.07 |
| 41 | Calculating heat loss and gain | 2.81 | .99 |
| 42 | Financing | 2.58 | 1.16 |

Rating: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 -- important; 5 -- essential

Table 7. Importance of being versed in construction practices for architectural draftsmen as viewed by employers

| Rank | Category | Mean | Standard deviation |
|---|---|---|---|
| 1 | Main structure familiarity | 3.75 | .94 |
| 2 | Roof construction and surfaces | 3.60 | .89 |
| 3 | Structural steel | 3.57 | .94 |
| 4 | Reinforced concrete | 3.55 | .96 |
| 5 | Site considerations | 3.54 | .95 |
| 6 | Masonry construction | 3.52 | .97 |
| 7 | Pre-cast concrete | 3.51 | .95 |
| 8 | Timber construction | 3.46 | .95 |
| 9 | Partitions and walls | 3.46 | 1.04 |
| 10 | Floors | 3.41 | 1.03 |
| 11 | Foundations | 3.40 | 1.05 |
| 12 | Carpentry | 3.39 | 1.06 |
| 13 | Footings | 3.38 | 1.04 |
| 14 | Millwork | 3.32 | 1.11 |
| 15 | Surveying | 3.31 | 1.02 |
| 16 | Cabinet making | 3.22 | 1.05 |
| 17 | Ventilation | 3.18 | .91 |
| 18 | Lighting | 3.16 | .88 |
| 19 | Heating | 3.15 | .89 |
| 20 | Air conditioning | 3.14 | .86 |
| 21 | Plumbing | 3.13 | .89 |
| 22 | Electrical wiring | 3.10 | .91 |
| 23 | Humidification | 3.07 | .91 |
| 24 | Cooling | 3.05 | .84 |
| 25 | Concrete mixes | 3.04 | 1.02 |
| 26 | Painting and decorating | 2.94 | 1.03 |
| 27 | Air cleaning | 2.91 | .94 |

Rating: 1 -- no value; 2 -- little importance; 3 -- desirable; 4 -- important; 5 -- essential

With the purpose to determine what level of education currently employed architectural draftsmen have completed, and how their employers evaluated their education, a study of Tables 8, 9, and 10 explained some interesting needs for education. These three tables were made from the information acquired from the questionnaire asking what level of education currently employed architectural draftsmen have completed and evaluate their training by three levels; well trained, adequately trained or poorly trained. Each employer indicated level of education by greatest number, next greatest, and third greatest number of employees and then evaluated the training. Table 8 was the most valuable of the three tables evaluating the greatest number of employees by levels of education. Note that as the level of education increased employers' evaluation of employees gained in tables. The employees, in the main, with vocational technical school education, some college education, college and university graduates were mostly rated as well trained or adequately trained. This showed the need for post-secondary education in the architectural drafting field.

Table 8. Level of education of greatest number of currently employed architectural draftsmen have completed in relation to employers evaluation of training

| | Well trained | Adequately trained | Poorly trained |
|---|---|---|---|
| Less than high school education | | 1 | |
| High school education | 3 | 9 | 10 |
| Armed forces schooling | | 1 | |
| Vocational technical school | 11 | 11 | 3 |
| Some college | 9 | 23 | 5 |
| College and university graduates | 25 | 20 | 3 |
| Skilled employees from other companies | 6 | 8 | |

Table 9 and Table 10 indicated that the second greatest and third greatest number of employees, respectively, follow closely the same pattern. It is also interesting to note in the three tables that "piracy" was exercised within the trade. Well and adequately trained personnel, obtained from other companies, were found in the category of skilled employees from other companies. It should be noted that in Tables 8, 9, and 10, there were two people with less than high school education working in the architectural

Table 9. Level of education of next greatest number of currently employed architectural draftsmen have completed in relation to employers evaluation of training

| | Well trained | Adequately trained | Poorly trained |
|---|---|---|---|
| Less than high school education | | | |
| High school education | | 3 | 6 |
| Armed forces schooling | 1 | 3 | 2 |
| Vocational technical school | 11 | 11 | 4 |
| Some college | 7 | 23 | 5 |
| College and university graduates | 10 | 8 | |
| Skilled employees from other companies | 6 | 3 | |

Table 10. Level of education of third greatest number of currently employed architectural draftsmen have completed in relation to employers evaluation of training

| | Well trained | Adequately trained | Poorly trained |
|---|---|---|---|
| Less than high school education | 1 | | |
| High school education | 5 | 9 | 11 |
| Armed forces schooling | 1 | | |
| Vocational technical school | 4 | 4 | 3 |
| Some college | 4 | 6 | 4 |
| College and university graduates | 8 | 1 | |
| Skilled employees from other companies | 3 | 5 | 1 |

drafting field. One individual was rated as adequately trained and one well trained.

Table 11 enumerated the percent of presently employed architectural draftsmen who have received their formal training in the state of Iowa. Forty-nine responding firms, or 30.25 percent, said that 90 to 100 percent of their employees were trained in Iowa. And furthermore, 58.02 percent stated that over 50 percent of their employees had been trained in Iowa. One respondent commented that he is presently seeking a draftsman.

Table 11. Present percent of employed architectural draftsmen who have received formal training in state of Iowa

| Percent of training | Number | Percent |
|---|---|---|
| No response | 14 | 8.64 |
| 0% to 10% | 31 | 19.14 |
| 10% to 20% | 1 | .62 |
| 20% to 30% | 5 | 3.09 |
| 30% to 40% | 10 | 6.17 |
| 40% to 50% | 7 | 4.32 |
| 50% to 60% | 11 | 6.79 |
| 60% to 70% | 9 | 5.55 |
| 70% to 80% | 13 | 8.02 |
| 80% to 90% | 12 | 7.41 |
| 90% to 100% | 49 | 30.25 |
| Total | 162 | 100.00 |

The respondents were asked what the minimum level of education an architectural draftsman could have and still meet the needs of their firm. The data in Table 12 projected that 44.45 percent of the firms needed vocational technical school graduates to meet their minimum needs, while 26.53 percent would only require a high school education. Taking

students with a vocational technical school level of education and some college together would account for 61.74 percent of the needs of firms. Those people could be supplied by area vocational technical schools and area community colleges. Only 6.18 percent needed to be college or university graduates. All but one responding firm desired students to have at least a high school education. One employer commented "any of the above with right experience, general on-the-job experience, would be O.K.".

Table 12. Minimum level of education an architectural draftsman could have and still meet the needs of the firm

| Education | Number | Percent |
|---|---|---|
| No response | 2 | 1.23 |
| Less than high school education | 1 | .62 |
| High school education | 43 | 26.53 |
| Armed forces schooling | 4 | 2.47 |
| Vocational technical school | 72 | 44.46 |
| Some college | 28 | 17.28 |
| College and University graduates | 10 | 6.18 |
| Skilled employees from other companies | 2 | 1.23 |
| | 162 | 100.00 |

To gain information for students choosing a career in architectural drafting, it was desired to ascertain what employers considered the annual starting salary to be, as well as the salary that could be expected with three years and five years experience. This information was found in Tables 13 and 14. An analysis of Table 13 revealed that 25.92 percent figured the annual starting salary should be $5,000 to $5,500. When listing together annual starting salaries of between $5,000 and $7,000 the information in the table accounted for 72.22 percent of the respondents. It was interesting to note that 12.96 percent thought the annual starting salary should be below $5,000.

Table 13. Employers response to annual starting salary for architectural draftsmen

| Annual salary | Number | Percent |
|---|---|---|
| No response | 5 | 3.09 |
| Below 5,000 | 21 | 12.96 |
| 5,000 to 5,500 | 42 | 25.92 |
| 5,500 to 6,000 | 23 | 14.20 |
| 6,000 to 6,500 | 30 | 18.52 |
| 6,500 to 7,000 | 22 | 13.58 |
| 7,000 to 7,500 | 16 | 9.87 |
| 7,500 to 8,000 | 1 | .62 |
| 8,000 to 8,500 | 1 | .62 |
| Above 8,500 | 1 | .62 |
| | 162 | 100.00 |

In examination of Table 14 we found that 29 respondents, or 17.90 percent, indicated the annual salary with three years experience should be between $7,000 and $7,500. Seventy four and sixty nine hundredths percent listed an annual salary between $6,000 and $8,500 for persons with three years experience. With five years experience demonstrated, the data revealed that 56.80 percent of all respondents thought the annual salary should be between $7,000 and $9,000. In this five year section of the table there were 10.49 percent indicating a $10,000 to $10,500 salary should be paid. The five year section of Table 14 also showed several higher salaries with one respondent listing a salary of $14,000 to $14,500 and one even $15,000 to $15,500, which was the highest.

Table 13 and Table 14 revealed a good upward pay trend for increasing experience in the architectural drafting field.

A review of Table 15 revealed the change in employment structure of firms with architectural draftsmen. In 1965 there were more licensed

Table 14. Employers response to annual salary of an architectural draftsman with 3 years and 5 years of experience

| Annual salary | 3 years | | 5 years | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| No response | 12 | 7.41 | 12 | 7.41 |
| Below 5,000 | 0 | .00 | 0 | .00 |
| 5,000 to 5,500 | 2 | 1.23 | 0 | .00 |
| 5,500 to 6,000 | 7 | 4.32 | 2 | 1.23 |
| 6,000 to 6,500 | 26 | 16.05 | 5 | 3.08 |
| 6,500 to 7,000 | 23 | 14.20 | 6 | 3.70 |
| 7,000 to 7,500 | 29 | 17.90 | 22 | 13.58 |
| 7,500 to 8,000 | 22 | 13.58 | 23 | 14.20 |
| 8,000 to 8,500 | 21 | 12.96 | 24 | 14.82 |
| 8,500 to 9,000 | 10 | 6.18 | 23 | 14.20 |
| 9,000 to 9,500 | 6 | 3.70 | 10 | 6.18 |
| 9,500 to 10,000 | 1 | .62 | 5 | 3.08 |
| 10,000 to 10,500 | 2 | 1.23 | 17 | 10.49 |
| 10,500 to 11,000 | 0 | .00 | 1 | .62 |
| 11,000 to 11,500 | 0 | .00 | 3 | 1.85 |
| 11,500 to 12,000 | 0 | .00 | 0 | .00 |
| 12,000 to 12,500 | 1 | .62 | 6 | 3.70 |
| 12,500 to 13,000 | 0 | .00 | 1 | .62 |
| 13,000 to 13,500 | 0 | .00 | 0 | .00 |
| 13,500 to 14,000 | 0 | .00 | 0 | .00 |
| 14,000 to 14,500 | 0 | .00 | 1 | .62 |
| 14,500 to 15,000 | 0 | .00 | 0 | .00 |
| 15,000 to 15,500 | 0 | .00 | 1 | .62 |
| Total | 162 | 100.00 | 162 | 100.00 |

Table 15. Composite of employment data obtained from questionnaire table

| | Employed | | Estimated additional need | | | Totals |
|---|---|---|---|---|---|---|
| | Jan. 1 1965 | Jan. 1 1968 | Jan. 1 1969 | Jan. 1 1971 | Jan. 1 1973 | |
| Total licensed architects and/or professional engineers | 418 | 532 | 91 | 102 | 114 | 307 |
| Total architectural draftsmen | 395 | 533 | 177 | 202 | 220 | 599 |

architects and/or professional engineers than architectural draftsmen. Today they are about equal in number. The estimated needs for the next five years, as illustrated in the table, was almost a two to one ratio for architectural draftsmen. Architectural draftsmen needed by Jan. 1, 1969, was 177, an additional 202 by Jan. 1, 1971, and an additional 220 by Jan. 1, 1973. The state of Iowa needed a total of 599 architectural draftsmen by Jan. 1, 1973. This was approximately 120 per year, which means that education must be prepared to meet this need.

Reported in Table 16, the number of architectural draftsmen employed on Jan. 1, 1968, by firms with 10 thru 19 and 20 thru 49 employees represented 52.16 percent. Eighty-four and eighty-one one hundredths percent, or 452 of 533, were employed in firms whose size was from four thru 99 employees. There were no firms whose employees size was from 500 thru 849.

A study of Table 17 indicated that firms of size four thru 49 will need the greatest number of architectural draftsmen, Jan. 1, 1969 thru '73. In a five year period they will need 455 of the 599, or almost 76 percent, of the future architectural draftsmen in the state of Iowa. In both Table 16 and Table 17, the firm size 20 thru 49 ranked first in all cases. They have, as of Jan. 1, 1968, 143 employees and will need 47 more by Jan. 1, 1969, an additional 61 by Jan. 1, 1971, and an additional 68 by Jan. 1, 1973, for a total needed by firms of size 20 thru 49 in the five year period of 176 architectural draftsmen.

Table 16. Employment of architectural draftsmen on Jan. 1, 1968 by size of firm

| Size | Number | Percent |
|---|---|---|
| No response | 20 | 3.75 |
| Less than 4 | 31 | 5.81 |
| 4 thru 9 | 89 | 16.70 |
| 10 thru 19 | 135 | 25.33 |
| 20 thru 49 | 143 | 26.83 |
| 50 thru 99 | 85 | 15.95 |
| 100 thru 249 | 8 | 1.50 |
| 250 thru 499 | 6 | 1.13 |
| 500 thru 849 | 0 | .00 |
| 850 or more | 16 | 3.00 |
| Total | 533 | 100.00 |

Table 17. Architectural draftsmen needed by Jan. 1, 1969, Jan. 1, 1971 and Jan. 1, 1973 by size of firm

| Number of employees | Jan. 1, '69 | Jan. 1, '71 | Jan. 1, '73 | Total |
|---|---|---|---|---|
| No response | 4 | 8 | 10 | 22 |
| Less than 4 | 20 | 17 | 18 | 55 |
| 4 thru 9 | 46 | 44 | 58 | 148 |
| 10 thru 19 | 41 | 46 | 44 | 131 |
| 20 thru 49 | 47 | 61 | 68 | 176 |
| 50 thru 99 | 13 | 22 | 17 | 52 |
| 100 thru 259 | 2 | 2 | 2 | 6 |
| 250 thru 499 | 3 | 2 | 3 | 8 |
| 500 thru 849 | 0 | 0 | 0 | 0 |
| 850 or more | 1 | 0 | 0 | 1 |
| Total | 177 | 202 | 220 | 599 |

Additional architectural draftsmen needed in the state of Iowa by merged areas is outlined in Table 18. From the "totals" column, the total of 599 were needed in the state of Iowa in the next five years. Area XI, centered around Des Moines, needed the greatest number, 195. Second greatest was Area X, centered around Cedar Rapids and needing 77. Third was Davenport, Area IX, with 63. The breakdown of the merged areas may either be determined from Table 18 or Figures 1, 2, and 3. These showed that by Jan. 1, 1969, there were 58 architectural draftsmen needed in Area XI, 22 in Area X and 21 in Area IX. Between Jan. 1, 1969, and Jan. 1, 1971, an additional number were needed with 65 in Area XI, 25 in Area X, and 18 in Area IX. From Jan. 1, 1971, to Jan. 1, 1973, an additional 72 architectural draftsmen are needed in Area XI, 30 in Area X, and 24 in Area IX. Even though Area VIII is not an approved area there was a total demand for 37 architectural draftsmen in the next five years. Area V and Area II show a constant increasing demand with a total of 49 and 44 needed, respectively. Area XIV, as noted previously, had no need for architectural draftsmen. Figures 1, 2, and 3 pictorially emphasize the data of Table 18.

Table 18. Additional architectural draftsmen needed in the state of Iowa by merged area

| | Jan. 1, '69 | Jan. 1, '71 | Jan. 1, '73 | Total |
|---|---|---|---|---|
| State | 177 | 202 | 220 | 599 |
| I | 6 | 5 | 5 | 16 |
| II | 12 | 15 | 17 | 44 |
| III | 2 | 3 | 2 | 7 |
| IV | 3 | 6 | 7 | 16 |
| V | 14 | 15 | 20 | 49 |
| VI | 8 | 8 | 5 | 21 |
| VII | 5 | 10 | 6 | 21 |
| VIII | 8 | 14 | 15 | 37 |
| IX | 21 | 18 | 24 | 63 |
| X | 22 | 25 | 30 | 77 |
| XI | 58 | 65 | 72 | 195 |
| XII | 11 | 13 | 10 | 34 |
| XIII | 0 | 1 | 1 | 2 |
| XIV | 0 | 0 | 0 | 0 |
| XV | 5 | 2 | 4 | 11 |
| XVI | 2 | 2 | 2 | 6 |

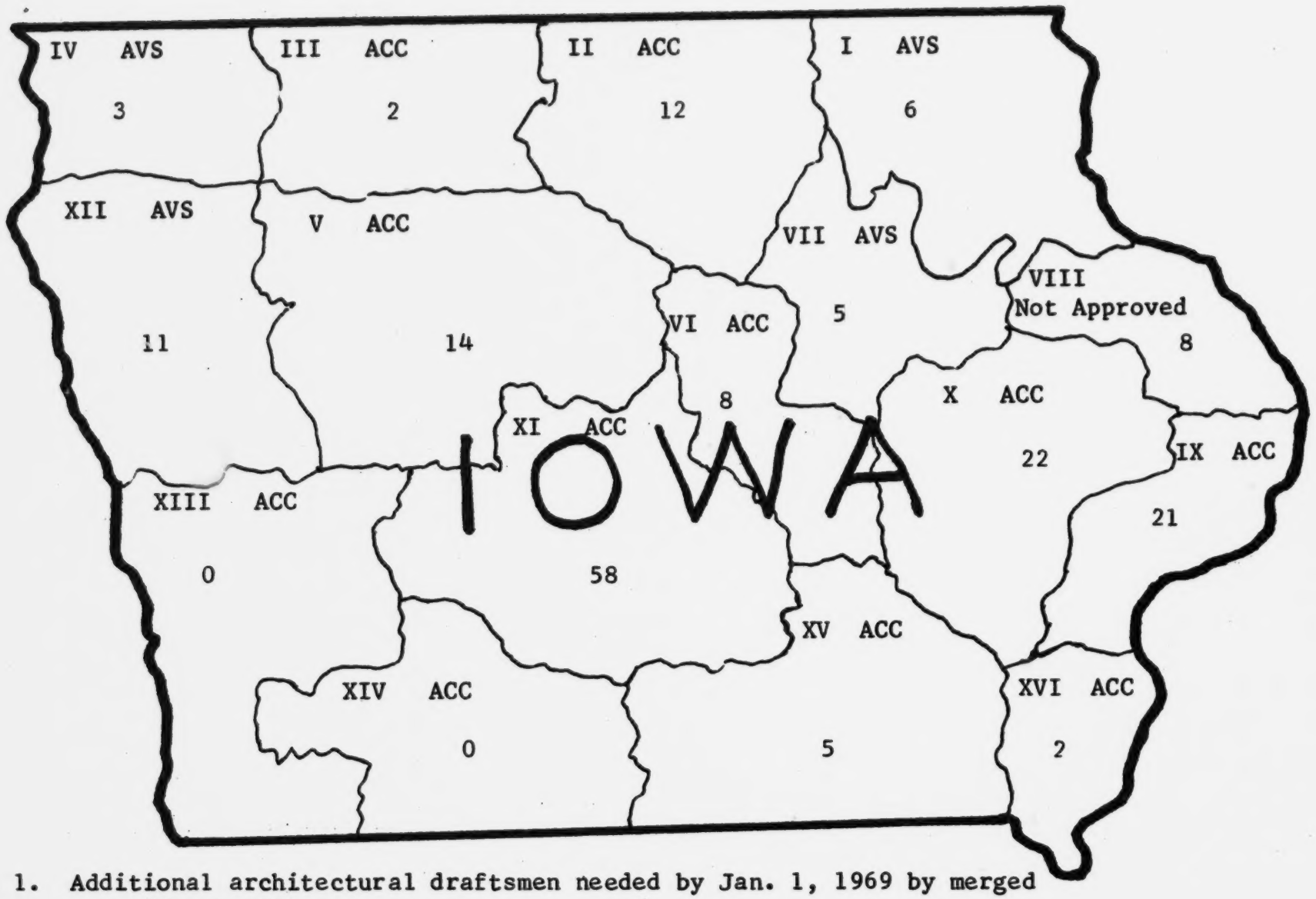


Figure 1. Additional architectural draftsmen needed by Jan. 1, 1969 by merged area (Total 177)

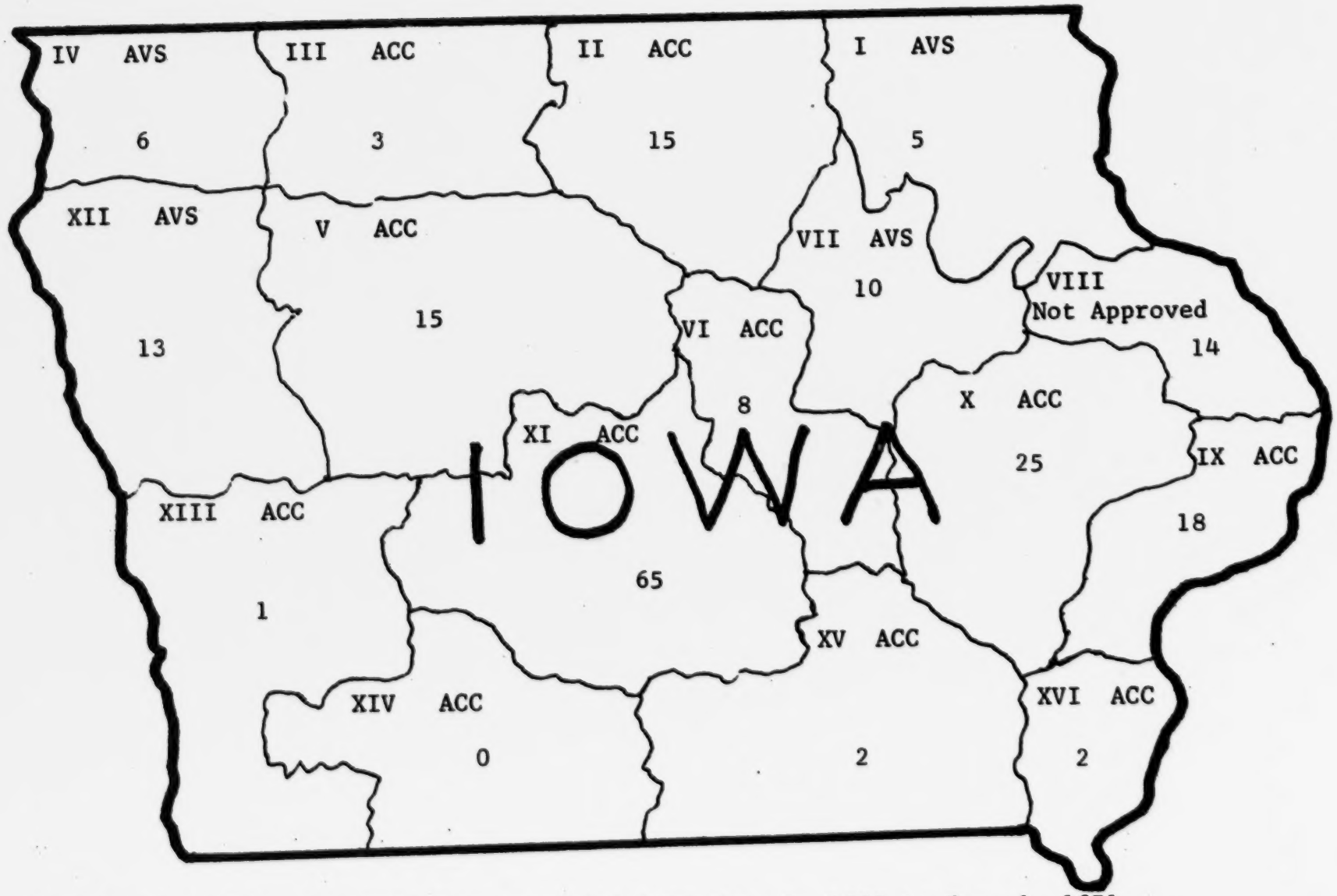


Figure 2. Additional architectural draftsmen needed from Jan. 1, 1969 to Jan. 1, 1971 by merged area (Total 202)

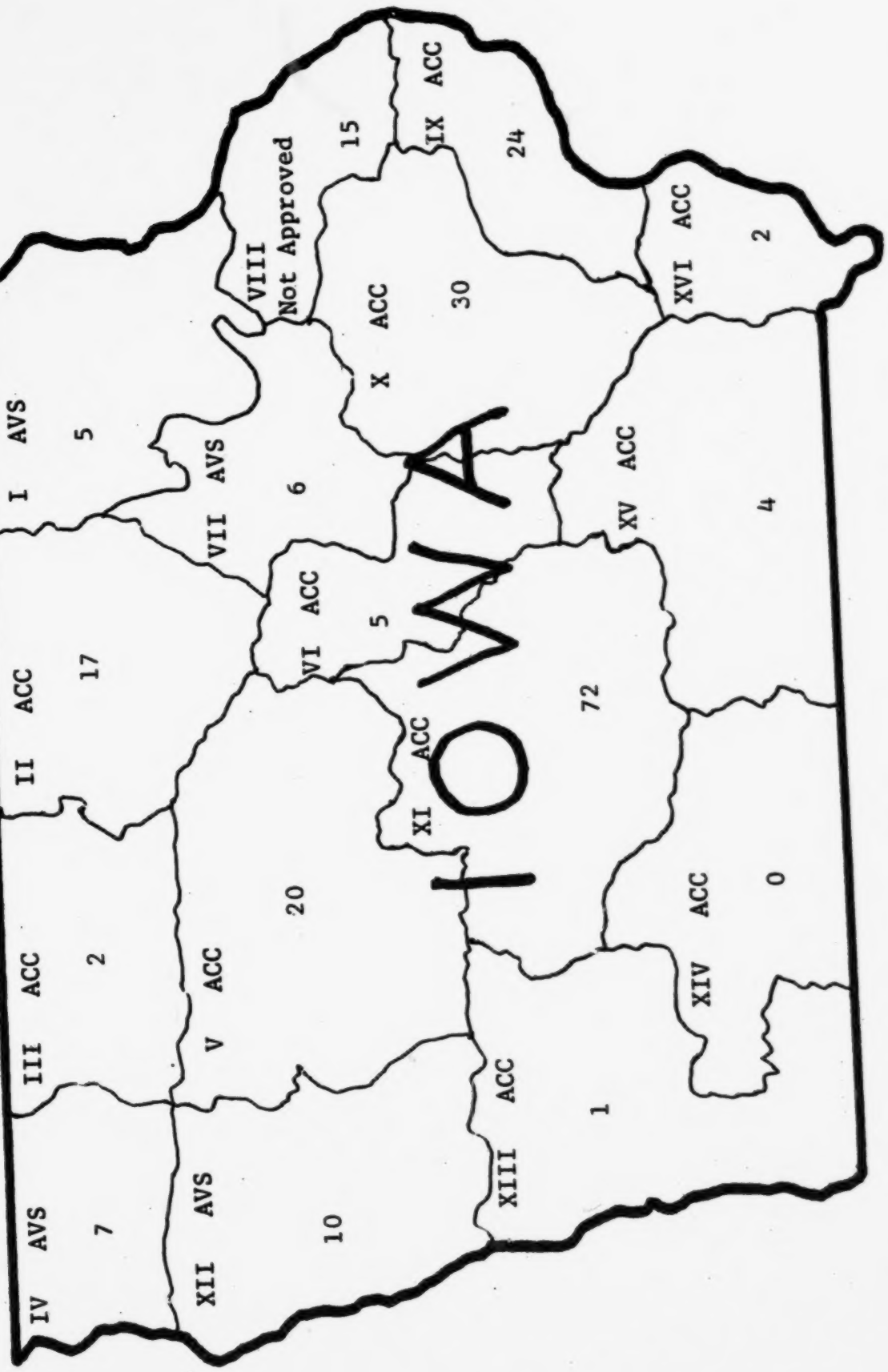


Figure 3. Additional architectural draftsmen needed from Jan. 1, 1971 to Jan. 1, 1973 by merged area (Total 220)

Table 19. Needed architectural draftsmen based on minimum level of education required by firm

| Education | Firms answering | Estimated additional need Jan. 1 1969 | Jan. 1 1971 | Jan. 1 1973 | Totals |
|---|---|---|---|---|---|
| No response | 2 | 0 | 5 | 5 | 10 |
| Less than high school education | 1 | 0 | 1 | 0 | 1 |
| High school education | 43 | 49 | 54 | 52 | 155 |
| Armed forces schooling | 4 | 3 | 3 | 4 | 10 |
| Vocational technical school | 72 | 93 | 97 | 111 | 301 |
| Some college | 28 | 23 | 30 | 34 | 87 |
| College and university graduates | 10 | 8 | 11 | 13 | 32 |
| Skilled employees from other comp. | 2 | 1 | 1 | 1 | 3 |
| Total | 162 | 177 | 202 | 220 | 599 |

Given in Table 19 were the needed architectural draftsmen based on minimum level of education required by the firm. Here the data reported that the vocational technical schools were first with a total need of 301 graduates. The minimum level of high school education was next high with a total need of 155. Here it is presumed that the student would have some architectural drafting in high school. Only one person with less than high school education will be needed in the next five years. The three categories, high school education, vocational technical school and some college account for 543 of 599 needed in the state, for approximately 91 percent of the needed architectural draftsmen.

An analysis of the data in Table 20 revealed the additional architects and/or professional engineers needed. This information was asked for in the questionnaire in order to insure a valid and reliable estimation of needed architectural draftsmen. As noted previously, the demand was about

two to one for architectural draftsmen. Area XI was high for each year and needed a total of 84 architects and/or professional engineers in the next five year period.

Intentionally, there was no attempt to compare or rank firms, and, of course, the questionnaires will remain confidential.

Table 20. Additional architects and/or professional engineers needed

| | Jan. 1, '69 | Jan. 1, '71 | Jan. 1, '73 | Total |
|---|---|---|---|---|
| State | 91 | 102 | 114 | 307 |
| I | 5 | 4 | 7 | 16 |
| II | 6 | 5 | 4 | 15 |
| III | 1 | 1 | 1 | 3 |
| IV | 0 | 3 | 1 | 4 |
| V | 9 | 14 | 10 | 33 |
| VI | 4 | 2 | 4 | 10 |
| VII | 4 | 4 | 3 | 11 |
| VIII | 3 | 4 | 8 | 15 |
| IX | 14 | 13 | 14 | 41 |
| X | 10 | 16 | 12 | 38 |
| XI | 24 | 24 | 36 | 84 |
| XII | 7 | 5 | 9 | 21 |
| XIII | 0 | 1 | 1 | 2 |
| XIV | 0 | 0 | 0 | 0 |
| XV | 4 | 4 | 4 | 12 |
| XVI | 0 | 2 | 0 | 2 |

## SUMMARY

This study was developed to determine the number of architectural draftsmen needed in the state of Iowa and the skills and knowledge they should possess. Also, it was to identify firms employing architectural draftsmen and what the present educational source was.

The study involved contacting 14 agencies and mailing 1,114 double postcard short form questionnaires to develop a comprehensive list of firms employing architectural draftsmen. The main questionnaire was developed, field tested and in its final form mailed to 297 Iowa industries, architects, and engineering firms. This main questionnaire was constructed in several parts to provide an overview of the objectives, both educationally and occupationally. A follow-up letter and several phone calls were utilized and 249 of the 297 firms returned the questionnaire. This was an 83.84 percent return. The usable returns were coded and recorded on two 80 column IBM business machine cards by key punch. These punched cards were utilized at the Computer Center at Iowa State University and the data was then presented in tabular and graphic form. Personal follow-up interviews were made to five area schools and leading Iowa industries, architects, and engineering firms nearby involved in the study to gain a clearer understanding of architectural drafting needs. This travel was to Eastern, Western and Central Iowa visiting Davenport, Muscatine, Cedar Rapids, Des Moines, Council Bluffs and Sioux City.

The objectives of this study were:

(1) to identify the Iowa industries, architects, and engineering firms which employ architectural draftsmen;

(2) to ascertain the skills and technical knowledge which the Iowa industries, architects, and engineering firms desire their architectural draftsmen to possess;

(3) to determine the number of architectural draftsmen needed to fill the needs of Iowa industries, architects, and engineering firms now and projected for the next five years;

(4) to determine the present source of architectural draftsmen being hired by Iowa industries, architects, and engineering firms.

Through prodigious effort, Iowa firms employing architectural draftsmen were identified. The employer wished the architectural draftsmen to be proficient in verbal communication, spelling, listening and note taking, advanced arithmetic, plane geometry, and basic algebra as well as the drafting practices of architectural blueprint reading, dimensioning, architectural lettering, architectural symbols, types of lines and line quality, detailing, architectural conventions, sections, elevations, and floor plans. In addition skills and technical knowledge in construction practices of main structure familiarity, roof construction and sur-

faces, structural steel, reinforced concrete and site considerations were desired.

The number of additional architectural draftsmen needed in the state of Iowa in the next five years is 599. Presently there are 533 so in the next five years this number should be more than doubled. Employers say the minimum level of education architectural draftsmen need is vocational technical school or some college education to meet the occupational needs of most firms. Most of the presently employed architectural draftsmen employed in Iowa received their formal training in Iowa and were well or adequately trained.

1) There is a definite need in the state of Iowa for well trained architectural draftsmen.

2) There is a need for the development of architectural drafting programs in Iowa Area Vocational Technical Schools and Iowa Area Community Colleges.

3) The main source of presently employed architectural draftsmen is colleges and universities.

4) It is very difficult for firms to predict the number of additional employees needed beyond one year.

5) It is recommended that a restudy be instituted in three to five years.

There is truth in the saying "While ideas are born in the mind of man, they are brought into being at the point of a pencil."

367V-557VE

# ADMINISTRATIVE CENTERS AND MERGED AREAS FOR AREA COMMUNITY COLLEGES (ACC) AND AREA VOCATIONAL SCHOOLS (AVS)

March 14, 1967